Including the effects of a harsh radiation environment in the simulation and design of nanoelectronic devices and circuits, Phase I

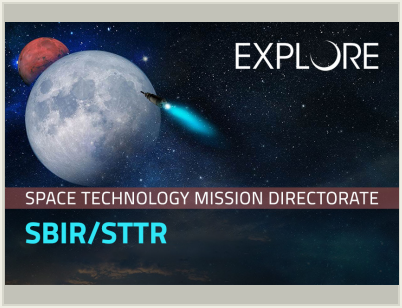
Completed Technology Project (2004 - 2004)

Project Introduction

Nanoelectronic devices, and circuits based on such devices, are expected to be more susceptible to the effects of radiation than the previous generation of devices and circuits. Circuits that can operate in harsh radiation environments are essential components of commercial satellite communications systems, space exploration vehicles, and national defense systems. Hence there is a critical need to understand and quantify the effects of radiation on the present and next generation of nanoelectronic circuits, and to develop methods to render such circuits insensitive to radiation. In this project we intend to identify and characterize (as a function of device dimension if possible) the deleterious effects of radiation on nanoscale devices. More importantly, we intend to build on the standard models, which describe the effects of radiation, and develop software that would enable the modeling and simulation of radiation effects. First we will consider conventional nanoelectronic devices --- that is those where charge transport is based on the usual principles of drift and diffusion. Then a tool for the effects of radiation on single electron transistors and amplifiers (including those based on carbon nanotubes) would also be developed. Using the software, methods to mitigate the effects of radiation by rad-hard designs will be examined.

Anticipated Benefits

Modeling and simulation tools are essential during every stage of the design and fabrication of electronic circuits --- such tools enable tremendous savings in time and cost. There is general agreement, among engineers who must tackle the issue of radiation hardness, about the urgent need for software tools in this area. The primary customers are expected to be engineers in industrial laboratories, researchers in the DOD and government laboratories, academic researchers, and chip designers. In many of NASA's spaceflight programs, commercial off-the-shelf (COTS) components are the only components that can provide the required performance, and meet physical requirements such as weight, power consumption, volume, etc. The effects of radiation on COTS integrated circuits are fairly complex. Hence there is ongoing work at NASA in the development, selection or preparation of electronics that can operate in the space radiation environment. This proposed software tool would assist in the aforementioned development efforts, and can contribute to the program on radiation hardness assurance of electronics components.



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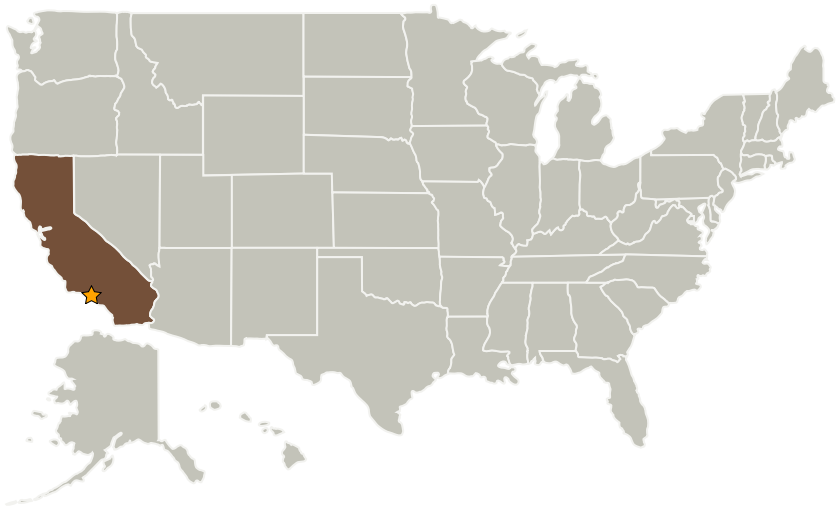
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California
Qusemde	Supporting Organization	Industry	Belmont, California

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Celestino Jun Rosca

Principal Investigator:

Wayne Richardson

Technology Areas

Primary:

- TX02 Flight Computing and Avionics
  - TX02.3 Avionics Tools, Models, and Analysis
    - TX02.3.2 Space Radiation Analysis and Modeling